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Exotech Systems, Inc.

January 15, 1973

National Aeronautics and Space Administration
Headquarters
Planetary Quarantine Office
Washington, D. C. 20546

Attention: Lawrence B. Hall Code SL

Subject: Third Quarterly Progress Report, Contract NASw-2372, Scientific and Technical Services for Development of Planetary Quarantine Measures for Automated Spacecraft.

Gentlemen:

This letter constitutes the third quarterly progress report summarizing work for the period October 1 through December 31, 1972 on the contract cited above.

Emphasis during this reporting period was placed on the following activities:

- Identification of PQO-sponsored research supporting the enumeration of parameters.
- Assistance in the organization of material for Chapter IV of "Foundations of Space Biology and Medicine."
- Preparation of material for the AIBS PQ Panel Meeting, Atlanta, October 5-6, 1972.

I PROGRESS AND STATUS

Progress of the contract is summarized in terms of factual data, status and progress on each active task. To facilitate your review we have deleted the separate analysis section and provide our interpretation of results and recommendations for further action within the progress and status report. A final summary section lists action items and conclusions.

Task 1 Evaluation of the Impact of Changes in Planetary Quarantine Requirements

The Planetary Quarantine Officer, with the assistance of such groups as the AIBS PQ Panel, members of the NASA LSC and the SSB, as requested, continuously reviews and reassesses quarantine requirements and constraints imposed upon space flight projects. Under this task, evaluations are conducted to support the justification and establishment of these requirements and to estimate their implications upon flight projects.

Work performed during this reporting period related principally to the continuing review by members of the SSB and the LSC of PQ constraints imposed upon flight projects. In addition to values for the probability of microbial growth for Mars and Jupiter, other specifications, such as dry heat sterilization characteristics, have been reviewed as has the experimentation which has led to the selection of values for key parameters.

We have compiled pertinent data to assist the PQO in these reviews. Specifically we have:

- Compiled and issued a booklet of "Planetary Quarantine Specification Sheets" (PQ-439)
- Prepared a specification sheet for the probability of microbial survival during space travel
- Summarized PQO-sponsored research supporting parameter enumeration.

Research summarization is continuing and presentation material will be prepared for the LSC meeting scheduled for January 23, 1973.

Task 2 Maintain and Operate the Planetary Quarantine Document System

The Quarantine Document System (QDS) is an indexed file of material pertinent to the review of flight project quarantine plans and operations. This task covers the operation, maintenance and updating of the system.

The collection experienced continued growth and use. During the reporting period, 40 documents were added to the collection bringing the total to 480.

Utilization of the QDS has increased significantly in supporting evaluations and analyses performed both by Exotech and the PQO's staff.

Task 3 Microbial Contamination Logs

COSPAR has asked each launching nation to supply it with information on all planetary missions that will permit the maintenance of a contamination log. The microbial contamination log fulfills this requirement and is submitted to the PQO for presentation to the COSPAR PQ Panel at its annual meetings. This task covers the maintenance of logs for actively-studied planets of biological interest and the timely submission to the PQO of pertinent contamination data.

The status of planetary contamination logs is as follows:

Mars	Latest revision	December 31, 1971
Venus	Latest revision	December 31, 1971
Jupiter	Original Version	June 30, 1972

Activity on this task during the reporting period consisted of the acquisition of information to be included in subsequent updatings of these logs.

A presentation of this task is planned for the January AIBS Semi-Annual Spacecraft Sterilization Seminar.

Task 4 Maintenance of Allocation Bank

The United States and the Union of Soviet Socialist Republics plus other launching nations have been allotted a portion of the total probability of contamination of each planet of our solar system based on an estimate of the total number of missions to be flown by each nation. From these data, the Planetary Quarantine Officer makes pre-launch allocations of the probability of contamination allotted to each launched spacecraft. Following the space flight, unexpended portions of the allocation to any mission event that is completed successfully may be recaptured and redistributed by the Planetary Quarantine Officer to follow-on missions.

To assist the Planetary Quarantine Officer in making the most liberal allocation, consistent with COSPAR policy, to each United States mission, Exotech maintains relevant data for all US flights launched to date. The bank is resident in a portion of the PQ Status Board, located in the offices of the PQO. Among the information contained is:

- Allocations (original and revised) assigned to all US missions

- Estimates of probability of contamination based upon post-launch analysis for all US missions (updated as necessary)

- Cumulative balances for each planet of Assigned and Expended Totals.

A presentation on this task is scheduled for the AIBS Semi-Annual Spacecraft Sterilization Seminar in New Orleans.

Task 5 Creation and Maintenance of List of Approved Parameters

Uniformity of policy and document review can be facilitated through a listing of parameters employed by flight projects in validating compliance with PQ requirements. This task covers the preparation of such a listing with definitions and approved numerical values or ranges.

Two categories of parameters have been identified and are monitored under this task. These are:

1. PQO issued parameters (includes those specified by the PQO, such as D values, P(r), etc., as well as those determined or recommended by others and submitted to the PQO for issuance to flight projects).

2. PQO approved parameters (includes parameters described and enumerated by flight projects and submitted in project plans for PQO approval. Examples include: P(uv) for Project X, P(I), for Project Y, etc.).

A listing of candidate parameters in both categories was presented in the last quarterly report. These were further evaluated during this reporting period. Twenty-two (22) parameters of the 1st category were documented and submitted to the PQO as PQ-439. Supporting technical material was attached to facilitate the review and use of these data.

Data of the second category have been compiled for documents from the Mariner, Pioneer and Viking projects. Results will be tabulated and summarized for future submittal.

Task 6 Preparation of Technical Information Memo

The Planetary Quarantine Technical Information Memo (TIM) is a brief, informal newsletter containing summaries of research results of note, meetings, significant travel plans, policy decisions, changes in personnel, initiation of new research tasks, and management deadlines. It is submitted to ninety-five (95) people involved in the PQ program.

Two TIMs (#6 and #7) were issued during this reporting period. They highlighted results of the AIBS PQAP meeting in Atlanta and the Integrated Life Sciences meeting at NASA, November 14–15, 1972.

Task 7 Evaluation of Flight Project Quarantine Plans

Implementation of PQ requirements by flight projects is effected through a set of plans and related documents by which PQ-related tasks are guided and controlled. The purpose of this task is to support the PQ Officer in his review and evaluation of these documents to ensure flight project compliance.

Activity during this reporting period included:

1. Review of the MVM '73 PQ Plan (See PQ-452, 453 and 456)
2. Review of the Pioneer G Prelaunch Analysis (See PQ-485)

The need was stressed for the resolution of PQ requirements for the outer planets including their satellites.

Task 8 Supporting Analysis of Planetary Quarantine Sterilization Parameters

This task is directed toward the establishment of more definitive PQ parameters which can be utilized in flight project implementation of PQ requirements.

During the reporting period we reviewed Dr. Henry J. Moore's assessment of projectile impact data contained in "An Estimate of Spacecraft Behavior on Impact with Natural Surfaces" (PQ-414). Results correlated well with our earlier analysis of the Boeing Company impact test data. Where differences were noted (no fracture below 750 ft/sec), they were not significant in influencing release parameter values.

The WSMR information has increased the quantity of data available for analysis and provides test data on a wider variety of surface conditions and vehicle configurations.

An interim report covering the impact of the WSMR data is in preparation.

Task 9 Preparation of Technical Presentations

This task relates to the preparation of written and graphic materials for publications, briefings and speeches on PQ subjects.

During the report period materials relating to the following presentations and documents were prepared and delivered:

- Handouts for the members of the AIBS PQ Panel at the October 5–6, 1972 meeting, Atlanta.
- Presentation material for the Integrated Life Sciences meeting, NASA, November 14–15, 1972.

A major effort during this reporting period was the preparation of Chapter IV of "Foundations of Space Biology and Medicine" to combine the U.S. and the English translations of the U.S.S.R. versions with rough drafts of material by U.S. authors on new topics not included in previous publications.

A final draft of the document was completed and submitted to the U.S. Editor.

Task 10 Technical Support at Meetings

Under this task, Exotech provides technical support for the PQO as may be required at meetings of the Life Sciences Committee, COSPAR, flight project planetary quarantine working groups, experimenters, and others.

Technical support provided by Exotech during this reporting period included meeting and pre-meeting consultation and discussions relating to the following meetings in addition to those cited in earlier tasks:

- November 8–9, 1972, LaRC meeting on planetary quarantine planning for Viking '75.
- December 6, 1972, KSC meeting on thermal inactivation of naturally-occuring microorganisms.

Task 11 Support of Technology Transfer

In addition to the elements of technology transfer support relating to tasks 9 and 10, the effort required herein involves serving as a source of PQ technology information upon referral of inquiries by the PQO and assisting in the development of the agenda for meetings of the PQ group.

During the reporting period there were no requests from outside the PQO and his staff for technology information. Assistance was provided, however, in the development of the agenda for the PQ group meeting at Atlanta, October 5–6, and the LSC meeting scheduled for January 23, 1973.

Task 12 Preparation of Planetary Quarantine Schedule

Contract Modification #1 dated October 2, 1972 requested that PQ schedule information be supplied as part of the Technical Information Memo (Task 6).

Task 13 Integrated Resumes of NASA Research

There was no activity under this task during this reporting period. Candidate topics for treatment during the remainder of the contract are discussed in the following Section.

II SUMMARY OF OPEN ITEMS

Items requiring further action or decision are enumerated below:

1. Specification of D-Values for Naturally-Occuring Populations

Research currently being pursued will produce data on the deactivation rates of naturally occuring spore populations at KSC spacecraft assembly sites. Analysis of the results of this research will be necessary to provide important inputs to the development of D-value specifications for terminal heat cycles for spacecraft. The analyses must address the question of the impact of new data on the dry-heat sterilization cycles developed from similar research with the test organism B. subtilis.

Knowledge of the dry-heat deactivation characteristics of the KSC naturally-occuring population will provide a basis for sensitivity analyses which treat an appropriate range of D-values in evaluating the reduction of bioburden by a dry-heat cycle.

2. Probability of Growth (P(g)

In view of currently planned flight missions to Mars and the outer planets, it is recommended that increased attention and effort be directed to evaluation of any relavent information uncovered since the last SSB consideration of this parameter. Such evaluations should focus on the basis for comparibility of the probability of growth of terrestial organisms on Mars and on the Jovian bodies. This matter requires prompt attention because of the schedule for the Pioneer G launch. This mission, which includes an option for Saturn fly-by opens up the question of allocations and requirements for that planet and its satellites, one of which (Titan) was recently singled out by Dr. Carl Sagan as being of particular scientific interest. The matter of the resolution of the probability of growth for outer planets appears to be a reasonable issue to address to the SSB.

Please advise if additional information is desired. We are prepared to discuss this material with you at your earliest convenience.

Very truly yours,

EXOTECH SYSTEMS, INC.

Edward J. Bacon

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